

Fig. 3. *Caligus tenax*, ♂, Heller, from beneath.

3 a. Hamulus anterior.

Fig. 4. *Caligodes carangis*, ♀, sp. n., from the back, enlarged.

4 b. The same in profile. 4 c. Genital segment and abdomen.

4 d. Cephalothorax from beneath, much enlarged. 4 e. Last

joint of the first pereopod. 4 f. Third pereopod.

4 g. Caudal plates. 4 h. Last joint of the posterior an-

tenna. 4 i. Second maxilliped. 4 j. Fourth pereopod.

4 k. Furcula from the side.

PLATE XII.

Fig. 1. *Alebion carchariæ*, ♀, Kr., from the back, enlarged.

1 a. Second maxilliped, much enlarged. 1 b. First and second

pereopods. 1 c. Third and fourth pereopods. 1 d. Margin

of the genital segment. 1 e. Extremity of posterior process

of the genital segment.

Fig. 2. *Lernanthropus nudus*, ♀, sp. n., seen from the back, enlarged.

2 a. The same seen from the side. 2 b. Cephalothorax, much

enlarged, from beneath. 2 c. Part of the margin of the

first pereopod. 2 d. Abdomen and posterior processes,

showing ovarian tubes and spermatophores attached.

Fig. 3. Male of the same, enlarged.

3 a. Male and female "in copulâ." 3 b. Anterior and posterior

antennæ. 3 c. Extremity of first maxilliped. 3 d. Abdo-

men and caudal plates.

Fig. 4. Embryos in two stages of development.

N.B.—The line to the right of a figure shows the natural length of the animal.

XLIII.—*Extraordinary Vitality of Entomostraca in Mud from Jerusalem.* By EDWARD ATKINSON, F.L.S.

JUST forty years ago, when, residing in Jerusalem, I was in the habit of using my scanty leisure in natural-history pursuits, I chanced upon a little discovery which has proved to be of no small interest.

Strolling one hot day in May 1858 by the margin of the old reservoir outside the Jaffa Gate, known as the Birket Mamilla, or Upper Pool of Gihon—then dry—I took a fancy to explore its bed. A few weeks had elapsed since the last of the water had been drawn off through its ancient conduit into the so-called Pool of Hezekiah within the city.

This Pool of Gihon, more than 2500 years old, was probably, when originally constructed, part of the system of pools and aqueducts by which water was brought from the Pools of Solomon at Urtas, beyond Bethlehem, for the supply of the capital; but now little or no water enters it from that source,

the pool being for the most part filled with surface-water during the rainy season.

On descending into it I observed that at the end where the water had rested last the thick layer of alluvial mud, which covered the floor of the pool to a depth of a foot or more, was densely silvered over with minute shells. These on examination proved to be the shields or carapaces of several kinds of Entomostraca.

It occurred to me that, as the pool only contained water during two months in the year, these animals, after so brief a life, must leave their ova in the mud, to reproduce their several species in the next rainy season, after entombment in the sun-baked mud for ten months.

The idea of testing the truth of this artificially occurred to me, and I took up carefully several pieces of the mud which had cracked in drying; these, as I knew nothing of the Entomostraca myself and was without books of reference, I sent to my friend Mr. Denny, A.L.S., then Curator of the Leeds Museum, with instructions when to moisten the mud. The result in his hands was such as to surprise and delight him. One after another new species of several genera sprang into life. Wisely he had not moistened all his mud; so he sent a little to Dr. Baird, of the British Museum, who was equally charmed with the experiment. Dr. Baird described and figured five new species in the *Ann. & Mag. Nat. Hist.*, Oct. 1859 (1 *Daphnia*, 1 *Diaptomus*, 1 *Estheria*, 2 *Cypris*), and, lastly (in Sept. 1861), a new *Branchipus*.

In order to ascertain whether the ova deposited in captivity would develop another year, I suggested to Mr. Denny that in the summer he should decant the water and dry off the mud without disturbing its surface. This he did by means of a syphon, leaving the mud dry till the following spring, in imitation of nature, when the glass jar was again filled. The experiment was quite successful, most, if not all, of the species reappearing.

At the end of 1860 I returned to England, and brought a fresh supply of the mud, portions of which were given to several gentlemen, who repeated the experiment, with similar results.

By alternating the seasons in the manner above described the crop was renewed year by year, most of the species living for two months, several for three months or more, then depositing their ova and dying. This was repeated at the Leeds Philosophical Society's Museum for eight years; and it was only in the winter of 1866 that an accidental exposure of the jar to a severe frost on the housetop destroyed them all.

An interesting fact illustrating the great vitality these ova possess is that a small quantity of the original stock of mud given to a friend had by him been put away in a pill-box and forgotten. Nine years after it turned up in his desk; little expecting any result, he placed it in a small glass jar and added water to it, but a fortnight later a single specimen of the *Estheria gihoni*, the rarest and most beautiful form, made its appearance.

Another friend, a clergyman in the South of England, to whom I gave a portion of the mud, and who had continued the process of alternating the wet and dry season for twenty-four* years with unvarying results, removed to Tunbridge Wells. During the change of residence the globe containing his dried mud was accidentally broken and thrown with other rubbish at the back of a rockery in the garden. Next spring its owner discovered it, to his dismay, in its ruined condition; but finding that the mud still remained adherent to the main fragment, he transferred it to a new globe of water, when, to his surprise, three weeks later his old friends appeared, as if nothing had happened, although the winter had been very severe and the broken globe was frequently buried in snow!

In 1896—an interval of thirty years having elapsed since I lost the succession of crops in my own aquarium—I availed myself of a friend's visit to Jerusalem to obtain a new supply from the same spot; and both last year and this I have had the pleasure of renewing my acquaintance with the now familiar forms. Together with my friend Mr. H. Crowther, F.R.M.S., the present Curator of the Leeds Museum, I have had six jars under observation. The same forms described by Baird appear regularly each season, especially the smaller species (*Daphnia* and the Cyprids), in every jar, whereas I observe that the larger forms (*Estheria* and *Branchipus*) were often one or both absent from one jar while numerous in another, which seemed to suggest that their ova did not in every case retain their vitality so well as the smaller kinds, or else that the ova of the larger species were less equally distributed, lying, as it were, in nests in one fragment of the mud and not in another; and, indeed, this seems to be the more likely explanation.

The following is Dr. Baird's list:—

* I learn from my friend that after 1884, "in the spring of which year all the forms seen before came to vigorous life, the mud remained carefully put away until given in 1894 to another friend," who, after the ten years' interval, again restored them to their annual activity, and this is maintained.

Branchipus eximius.

Estheria gihoni.

Daphnia Atkinsovi.

Cypris celtica.

Cypris orientalis.

Diaptomus similis.

The only additions I have ever observed were a *Cyclops* and several *Planariæ*.

The habits and movements of these Entomostracous Crustacea are most interesting to watch, especially the larger forms. *Branchipus*, which closely resembles our British *Chirocephalus*, from which it differs chiefly in the morphology of its cephalic horns or prehensile organs, swims, like *Chirocephalus*, upon its back, and, when shaded from a strong light, may be seen balancing itself near the surface by means of its numerous branchial feet, which are in constant motion. On the least disturbance, however, it strikes the water rapidly with the tail from right to left, darts away like a fish, and will often dive to the bottom to conceal itself in the soft mud. They are white and semitransparent, with the compound stalked eyes conspicuous as large black dots. The elegance and ease of their movements are very attractive, the male especially, which is somewhat larger than the female, with its singular curved horns lying forward on its thorax as it bends for a spring, and then suddenly straightening its body, glides along—the uninterrupted undulatory motion of its branchial feet gracefully waving like a tiny cornfield in the summer breeze—forms a charming study. Neither *Branchipus* nor the other forms seem dependent upon vegetable diet—at any rate, there is no plant-life in their native pool, unless it be some minute *Confervæ* invisible to the naked eye, and I have never detected any diatoms under the microscope. They seem, however, to derive their nourishment from the mud. It is pretty to watch the *Branchipus* use its prehensile horns like a pair of calipers to seize a mass of it, which raises a dense cloud in the water; then, turning on to its back, the undulating branchiæ form a current flowing along the sort of canal between them and leading to the mouth. M. Joly, in describing its congener, *Artemia salina*, says that the mother, surrounded by her newly-hatched brood, not unfrequently sweeps some of her own young into her omnivorous jaws by a similar process. This cannot happen to *Branchipus*, inasmuch as the brief existence of the individual never allows of the mother living to see her offspring.

Estheria gihoni seen in a glass of clear water is a beautiful object; it swims upright, with the finely-sculptured valves of its carapace slightly open, so as to allow part of its bright red body to be seen. The branchial feet are in constant motion except when the animal, after a lengthened swim, goes to the bottom and either burrows in the mud or falls over on its side on the surface, when the branchiæ move very feebly. When fully grown the male (which is somewhat larger than the female) measures 5 lines in its longest diameter. For the first month of life they seem to be continually active, but when adult are often in repose, sometimes for many hours together. When copulating the female is seized by the prehensile feet and held firmly by the strong hooks with which they are armed, and in this attitude, which looks as if she were carried in the male's mouth (almost like a dog with a rat), she is hurried along round and round the jar, the male retaining his hold for hours, and occasionally expanding the valves of the carapace in his flight.

The same evolution as above described in the case of *Branchipus*, of throwing up mud and sweeping it with the branchiæ towards the mouth, while turned on its back, is equally true of *Estheria*. I have kept the *Estheriæ*, *Daphniæ*, and *Cypridæ* for four months, but *Branchipus*, *Diaptomus*, and *Cyclops* are more short-lived.

XLIII.—*A Revision of the Pontoniidæ.* By L. A. BORRADAILE, M.A., Lecturer in Natural Sciences at Selwyn College, Cambridge.

THE first of the species of the Pontoniidæ was described by Foiskål in the year 1775, when he gave the name of *Cancer custos* to a small prawn found living in the mantle-chamber of a bivalve mollusk. In 1829, after certain wanderings, this species, under the name of *P. tyrrhena* (Risso), found a home in the genus *Pontonia*, established for it by Latreille; and by 1837, the date of publication of H. Milne-Edwards's 'Crustacées,' the number of species of *Pontonia* had risen to four. A closely allied genus, *Conchodytes*, was described by Peters in 1851.

After the appearance of Milne-Edwards's work no step of great importance in the history of the family was taken till Dana, in 1852, reporting on the Crustacea of the United States Exploring Expedition, separated from *Pontonia* groups